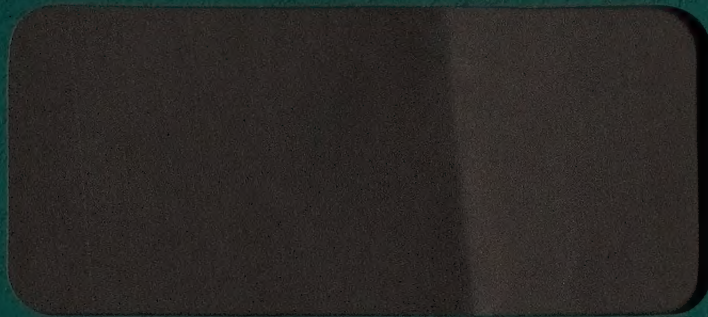


LORAIN

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instructions

INSTALLATION

OPERATION

MAINTENANCE

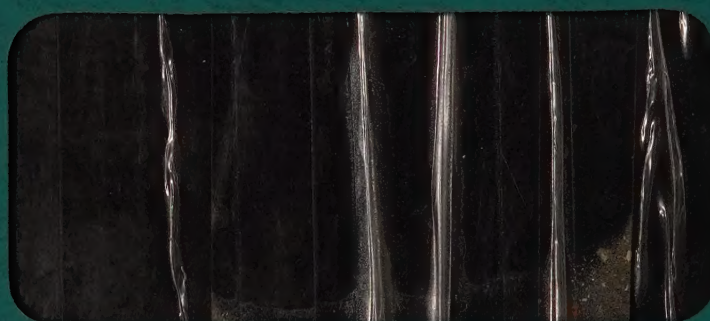
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NOTE

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MODEL CSTI

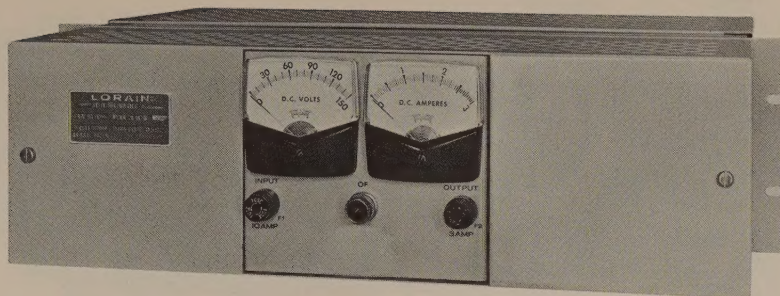
LORAIN CARRIER SUPPLY UNIT

Spec No 5664-013 Serial No 7552

INSTRUCTIONS
LORAIN MODEL CST1 CARRIER SUPPLY UNIT

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MODEL CST1

1. RATINGS

Input: 44 to 52 volt d-c; 9 ampere maximum

Output: nominal 130 volt d-c; 2 ampere full load rating

Model CST1 made to Spec. 5664-013 is wired for use with input battery with positive terminal grounded.

Model CST1 made to Spec. 5664-011 is wired for use with input battery with negative terminal grounded.

2. DESCRIPTION

LORAIN Model CST1 Carrier Supply Unit will maintain steady-state d-c output voltage within plus-or-minus 1 per cent at any load current between no load and full rated load, despite input d-c voltage variation between 44 and 52 volts.

Since d-c output is transformer isolated from d-c input, either positive or negative d-c output can be grounded regardless of input ground polarity. D-c output voltage and current are monitored by a voltmeter and an ammeter.

Two or more LORAIN Model CST1 Carrier Supply Units can be connected in parallel to supply additional current to 130 volt d-c load. Each unit is self-protected against overload; in event of

overload, d-c output voltage will decrease to limit output current.

If output failure should occur, an alarm lamp on the meter panel lights to indicate this condition. Provision is made to connect external output failure alarms.

3. INSTALLATION

a. Mounting

LORAIN Model CST1 Carrier Supply Unit is designed for nineteen-inch relay rack mounting. It requires 5-1/4 inches panel space, extends 4-7/8 inches to front of rack, and has overall depth of 12 inches.

CAUTION: In mounted position, ventilating openings at top and bottom of D-c to D-c Converter must be unobstructed. The temperature of the air entering the bottom of the cabinet should not exceed 50°C. A minimum of 1-3/4 inches of ventilation space should be provided between this unit and equipment mounted above or below it. This is essential to proper cooling during operation.

b. Electrical Connections

To gain access to input, output, and alarm connection terminals, remove rear cover from the Carrier Supply Unit. As viewed from the rear, these terminal strips are located at

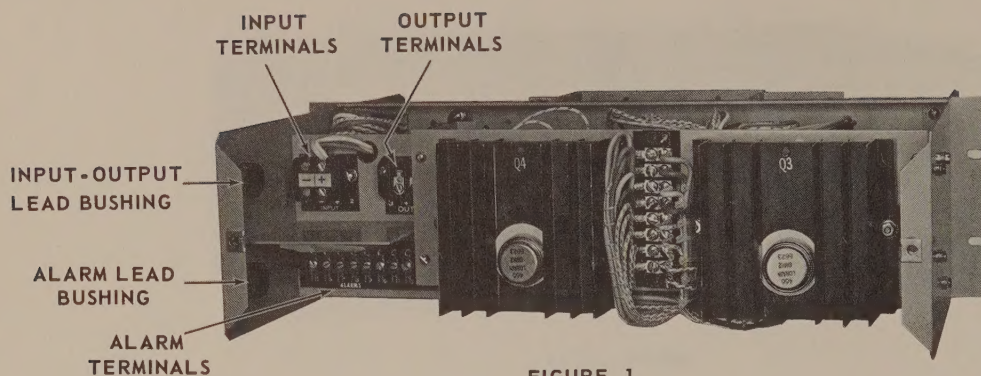


FIGURE 1
REAR VIEW OF CST1
WITH COVER REMOVED

the left hand side. To gain access to the optional output ground terminal strip, remove the front cover. Electrical lead entrance is by means of insulating bushings in rear cover bracket adjacent to terminals.

- (1) Insert 130 volt output power leads into terminals 3 (positive) and 4 (negative) of output terminal block TB2, then tighten terminal clamp screws to secure the leads. Output fuse F2, output diode CR12, and output ammeter are connected in series with positive d-c output for use in a positive (negative-ground) system; F2, CR12, and ammeter are connected in series with negative output for use in a negative (positive-ground) system.

Connect the following terminals together on ten terminal barrier strip TB4 (terminals numbered 14 through 23) for a negative-ground system:

14 to 19
15 to 20
16 to 17
17 to 18
21 to 22
22 to 23

For a positive-grounded system, connect the following terminals together on the barrier strip:

14 to 15
15 to 16
17 to 22
18 to 23
19 to 20
20 to 21

- (2) Supply nominal 48 volt d-c at input terminals 1 (negative) and 2 (positive) of input terminal block TB1. Tighten terminal clamp screws to secure leads.

CAUTION: Connect input directly to the 48 volt battery. Do not connect a filter between input battery and the Carrier Supply Unit as additional input filtering may cause voltage spikes which would damage transistors Q1, Q2, Q3 and Q4. When a battery eliminator supply is used, the output voltage of the supply must not exceed 65 volts peak upon transient load changes.

- (3) Alarm connections should be made to terminal strip TB3. Alarm terminals 5 and 6 supply ground while terminals 7 to 8 and 9 to 10 each furnish a closed loop if output failure should occur; closed loop alarm terminals in each of two parallel-connected units can be connected in series to operate a major alarm. Terminal 11 supplies alarm battery from negative input for Spec. 5664-013 and from positive input for Spec. 5664-011 to light alarm lamp OF.

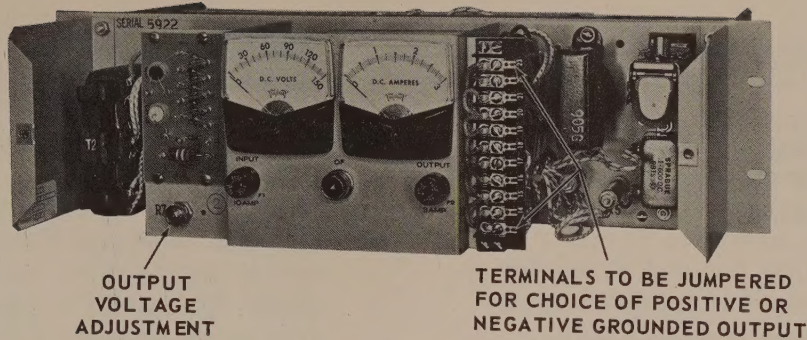


FIGURE 2
FRONT VIEW OF CST1
WITH COVER REMOVED

c. Adjustment

Check output voltage adjustment of LORAIN Carrier Supply Unit. Refer to Section 4, below.

NOTE: If two LORAIN Model CST1 Carrier Supply Units are connected for parallel operation, output voltage of each unit should be adjusted to a like value.

4. ADJUSTMENT

a. Output Voltage

Output voltage is continuously adjustable by means of potentiometer R7 located behind the front cover, adjacent to the meter panel. Refer to Figure 2, above. This potentiometer is factory-adjusted to nominal 130 volt output.

To increase output voltage, turn R7 screwdriver adjustment shaft clockwise; to decrease output voltage, turn shaft counterclockwise.

b. Factory Adjustments

Special factory adjustments are made on each LORAIN Model CST1 Carrier Supply Unit. It is recommended that no change be made in these adjustments:

- (1) Resistor R8 is adjusted to establish range over which potentiometer R7 will set d-c output voltage.

- (2) Setting of resistor R11 determines d-c output voltage regulation characteristics with respect to input d-c voltage variation.

- (3) Connections to control winding taps 9, 10, and 11 of magnetic amplifier T2 refine d-c output voltage regulation characteristics with respect to output current variation.

- (4) Setting of resistor R21 in parallel with resistor R19 adjusts value of d-c output current at which an output current limiter will begin to reduce d-c output voltage. Factory setting of this adjustment allows Carrier Supply Unit to deliver output voltage to which it is adjusted at rated output current of 2 amperes, but will cause output current limiter to decrease d-c output voltage to 80 volts if output current increases to 2.6 amperes.

5. OPERATION

a. General

Output voltage adjusting potentiometer R7 is located in back of the front cover adjacent to the meter panel.

b. Metering

D-c output voltage and output current are indicated by a voltmeter and ammeter.

c. Output Failure Alarm

If Carrier Supply Unit output should fail, this condition will be indicated by alarm lamp OF and, if connected, by an external alarm.

d. Fuses

Fuse F1 protects d-c input while fuse F2 can be connected in series with either positive or negative d-c output, as necessary to cause it to protect whichever side of d-c output is ungrounded. If necessary to replace either of these fuses, replace only with the following fuse types and sizes, or equivalent:

Input fuse F1: Bussmann Type ABC,
10 ampere

Output fuse F2: Bussmann Type AGC,
3 ampere

6. CIRCUIT DESCRIPTION

a. Input Circuit

Fuse F1 protects d-c input of this Carrier Supply Unit. Choke L1, with capacitor C1, forms an input filter which prevents transmission of switching transients from an oscillator, described below, to input battery.

b. Oscillator

Transistor Q1 and Q2 emitters are connected to positive input, and transistor Q3 and Q4 collectors are connected to negative input. Since negative input is also connected through resistors R15 and R13 to Q1 base, current initially flows from positive input through Q1 emitter and base, R13, and R15 to negative input. This drives Q1 to conduction and starts oscillation.

When transistor Q1 first conducts, current flows from positive input

through Q1 emitter and collector, primary windings of saturable transformer T1 between terminals 4 and 14, and Q3 emitter and collector to negative input. Current in T1 primary windings then induces current in T1 feedback windings between terminals 1 to 2, 3 to 4, 14 to 13, and 12 to 1. Feedback current drives Q1 and Q3 to maximum conduction while driving Q2 and Q4 to cutoff.

Once current begins to flow through Q1, T1 primary windings, and Q3, it increases rapidly until T1 becomes saturated. At this time, Q1 and Q3 limit T1 primary current and voltages developed across Q1 and Q3 emitters and collectors cause primary current decay.

When T1 primary current decays, transistor drive voltage polarities reverse. T1 feedback windings then drive Q2 and Q4 to maximum conduction while driving Q1 and Q3 to cutoff. When Q2 and Q4 conduct, current flows from positive input through Q2 emitter and collector, T1 primary windings between terminals 14 and 4, and Q4 emitter and collector to negative input. Note that current direction in T1 primary windings has now reversed. Again T1 primary current increases rapidly to saturate T1, at which Q2 and Q4 limit T1 primary current and voltages developed across Q2 and Q4 emitters and collectors cause primary current decay. Again transistor drive polarities reverse to drive Q1 and Q3 to conduction while driving Q2 and Q4 to cutoff.

This cycle occurs approximately 1000 times per second. Alternating T1 primary current induces higher voltage a-c in T1 secondary windings.

c. Power Circuit

Secondary winding of power transformer T1 furnishes a-c through end leg windings of magnetic amplifier T2 to

power rectifier CR1; CR1 rectifies this a-c and supplies resulting d-c through a T2 control winding, chokes L2 and L3, and output diode CR12 to load.

Resistance-capacitance network R5-C2 protects CR1 against voltage spikes. Chokes L2 and L3, with capacitors C3 and C4, make up an output filter which blocks switching transients from 130 volt load.

Output fuse F2, diode CR12, and an output ammeter can be connected in series with positive output if negative 130 volt d-c load is grounded or in series with negative output if positive 130 volt load is grounded.

d. Alarm Circuit

Resistor R16 and coil of relay K1 are connected in series across Carrier Supply Unit output. So long as d-c output remains uninterrupted, relay K1 remains operated; if output failure occurs, relay K1 releases. Contacts of relay K1, released, supply ground to light alarm lamp OF and operate external alarms through TB3 alarm terminals 5 and 6, and short alarm terminals 7 to 8 and 9 to 10 to operate external closed-circuit actuated alarms.

If additional Carrier Supply Units are connected in parallel with this unit, output diode CR12 blocks flow of output current from parallel-connected units which would otherwise hold relay K1 operated.

e. Magnetic Amplifier T2

Magnetic amplifier T2 is the circuit element which regulates Carrier Supply Unit output voltage.

As mentioned above, each of two end leg windings of magnetic amplifier T2 is connected in series between secondary windings of power transformer T1 and power rectifier CR1. Thus, d-c flows through alternate end leg windings of T2 on alternate a-c half-cycles. This cur-

rent is sufficient to saturate T2 for a portion of each a-c half-cycle.

So long as T2 is not saturated, a voltage appears across whichever end leg winding is carrying current. When T2 becomes saturated, however, this voltage is reduced sharply so that greater voltage is applied to CR1.

Direct current also flows through three T2 center leg control windings. Flux from this control current is either added to or subtracted from end leg winding flux, so that control current either aids or opposes T2 saturation to a greater or lesser extent, depending upon direction and amount of control current.

When control current aids saturation, it causes T2 to be saturated for a greater portion of each a-c half-cycle and increases effective voltage applied to power rectifier CR1; in similar manner, when control current opposes saturation, it causes T2 to be saturated for a lesser portion of each a-c half-cycle and decreases effective voltage applied to CR1. Since magnetic amplifier T2 controls effective CR1 voltage, it also controls Carrier Supply Unit output voltage.

As Carrier Supply Unit output current increases, resistive voltage drops tend to decrease its output voltage. However, as output current increases, T2 end leg winding current also increases. This causes T2 to be saturated for a greater portion of each a-c half-cycle, increasing effective CR1 voltage as output current increases, to maintain output voltage. As a further refinement, a T2 control winding is connected in series with positive output: as output current increases, flux from this winding further aids T2 saturation as necessary to compensate output voltage for output current variation.

f. Input Voltage Compensation

Resistances R10, R11, and R12 are

connected in series across d-c input of this Carrier Supply Unit. Also, a series circuit made up of a control winding of magnetic amplifier T2 and zener diode CR2 is connected in parallel with R12 and part of R11. This places an inverse voltage across CR2 which then causes it to conduct in reverse direction. Characteristics of CR2 are such that, once this occurs, an essentially constant voltage appears across CR2 while any increase or decrease of input d-c voltage will appear across R10 and part of R11.

A portion of d-c input voltage appears across R12 and part of R11. This voltage is compared to CR2 voltage through T2 control windings; any difference between these two voltages causes T2 control current to flow and cause T2 to compensate power rectifier CR1 voltage for any variation of input d-c voltage.

g. Output Voltage Compensation

An additional voltage control circuit both adjusts Carrier Supply Unit output voltage and compensates for any output voltage variation which is not completely equalized by circuits described above.

A series circuit, composed of diodes CR3 through CR11 and resistor R9, is connected across Carrier Supply Unit output. Diodes CR3 and CR4 are zener diodes, similar to diode CR2, which conduct in reverse direction and maintain essentially constant voltage. Since zener diode voltage increases slightly as temperature increases, temperature-compensating diodes CR5 through CR11 are also connected in this circuit. Voltage developed across diodes CR5 through CR11 decreases slightly as temperature increases to equalize CR3 and CR4 voltage increase. This results in constant voltage across diodes CR3 through CR11.

Series resistances R6, R7, and R8 are also connected across Carrier Supply Unit output so that voltage devel-

oped across resistor R8 and a portion of potentiometer R7 is proportional to Carrier Supply Unit output voltage. This voltage is compared with voltage developed across diodes CR3 through CR11 by connection through a control winding of magnetic amplifier T2; any difference between R8 and R7 voltage and diode voltage causes T2 control current to flow, as necessary to cause R8 and R7 voltage (developed as a portion of Carrier Supply Unit output voltage) to approach constant diode voltage. Since setting of potentiometer R7 determines portion of Carrier Supply Unit output voltage developed across R8 and adjacent portion of R7, this setting can be changed to change output voltage.

h. Output Current Limiter

Resistor R20 and diode CR13 are connected in series across d-c output. Since CR13 is a forward-biased silicon diode, it develops a low but essentially constant voltage. This voltage is applied to maintain emitter potential of transistor Q5 constant with respect to negative output of power rectifier CR1.

The parallel combination resistor R19 and R21 is connected in series with negative d-c output. Voltage developed across R19-R21 is, thus, proportional to d-c output current. So long as d-c output current does not increase beyond its rated value, R19-R21 voltage remains lower than constant CR13 voltage. Difference voltage between R19-R21 and CR13 causes negative base-emitter potential to be applied to Q5 at this time, to prevent flow of Q5 base current and drive Q5 to cutoff.

Resistor R21 is adjusted so that, as d-c output current increases beyond its rated value, R19-R21 voltage will increase to exceed CR13 voltage. This reverses potential of R19-R21-CR13 difference voltage, applies positive base-emitter potential to Q5 causes Q5 base current to flow and drives Q5 to conduction.

When Q5 conducts, current flows from positive d-c output through resistor R9, Q5 collector and emitter, and CR13 to negative d-c output. Note that Q5 emitter and collector, and CR13 are in shunt with diodes CR3 through CR11; since voltage developed across Q5 emitter and collector plus CR13 voltage is now lower than usual CR3 through CR11 voltage, current flows from positive d-c output through resistor R6, part of potentiometer R7, control winding between terminals 5 to 6 of magnetic amplifier T2, Q5 collector and emitter, and CR13 to negative d-c output. Since this current is opposite in direction to control current usually supplied through this T2 control winding, it opposes T2 saturation and causes T2 to decrease effective a-c voltage supplied to power rectifier CR1. Thus, T2 reduces d-c output voltage to prevent further increase of d-c output current.

7. TROUBLESHOOTING, GENERAL

These instructions give procedures for finding improper circuit conditions in a LORAIN Model CST1 Carrier Supply Unit. Possible trouble symptoms are listed in Section 8. Under each trouble symptom is a check procedure which will trace an improper condition to a small number of possible defective components. Even though early steps in a check procedure reveal possibly defective components, all steps indicated under a given symptom should be completed since failure in one component may also cause failure in other components.

When trouble has been limited to certain possible defective components, suspected components should then be checked individually. Section 9 gives specific test procedures for major components, together with necessary precautions to observe should replacement be necessary.

8. TROUBLE SYMPTOMS

<u>Symptom</u>	<u>Probable Cause</u>	<u>Check Procedure</u>
Output fuse F2 open	Overload	Check for conditions which might have caused overload and correct as necessary. Replace fuse F2.
Input fuse F1 open	Momentary overload	Replace fuse F1.
	Incorrect input polarity	Correct as necessary. If polarity was incorrect, two or more of transistors Q1, Q2, Q3 and Q4 may short out and cause F1 to open. Check transistors and replace if necessary. Replace fuse F1.
	Shorted capacitor C1, windings of choke L1 shorted to ground, or two or more of transistors Q1, Q2, Q3 and Q4 may be shorted.	Disconnect input and output leads. To be certain that input capacitor C1 and output capacitors C3 and C4 are completely discharged, temporarily short positive and negative output terminals. Measure resistance across positive and negative input terminals in both directions:

<u>Symptom</u>	<u>Probable Cause</u>	<u>Check Procedure</u>
		this resistance should be low initially, then it should increase as capacitor C1 charges. If resistance remains low, C1 may be shorted, windings of input choke L1 may be shorted to ground, or two or more of transistors Q1, Q2, Q3, and Q4 may have shorted. Measure resistance between terminal 2 of input choke L1 and terminal 4 or 14 of power transformer T1 in both directions. If this resistance is less than one ohm in both directions, transistor Q3 or Q4 may be shorted. Measure resistance between power transformer T1 terminal 1 and terminals 4 or 14 in both directions. Resistance less than one ohm in both directions indicates that transistor Q1 or Q2 may be shorted.
No output, fuses F1 and F2 intact	Choke L1 open, high resistance at input fuse	With input battery connected and input fuse F1 installed, measure d-c voltage between terminal 2 of input choke L1 and grounded input terminal. If input voltage does not appear between these two terminals, there is high resistance or an open-circuit at input fuse F1 or choke L1.
No output, fuses F1 and F2 intact, Carrier Supply Unit emits high pitched sound.	Open power transformer T1 secondary winding or open end leg windings of magnetic amplifier T2	Check for a-c voltage between terminals 6 and 16 of power transformer T1 and between terminals 1 to 2 and terminals 3 to 4 of magnetic amplifier T2. If no voltage appears between T1 terminals 6 and 16, T1 secondary windings may have opened; if voltage appears between T1 terminals 6 and 16 but no voltage appears between either set of T2 terminals, end leg windings of T2 may have opened.

<u>Symptom</u>	<u>Probable Cause</u>	<u>Check Procedure</u>
	Open circuit at output chokes L2, L3, output fuse F2 or output diode CR12	Check for a-c (ripple) voltage between white-red-brown wire connected to power rectifier CR1 and positive output. Diode CR12 should have high resistance in one direction and low resistance in the other. High resistance in both directions indicates an open circuit in CR12.
No output, fuses F1 and F2 intact, Carrier Supply Unit does not emit a high-pitch sound	Open starting resistor R13, R14 or R15, open diode section of CR1	Disconnect ungrounded input lead and check as follows: measure resistance between terminal 4 or 14 of power transformer T1 and terminal 2 of choke L1. This resistance should be approximately 375 ohms. Appreciably greater resistance may indicate an open starting resistor R14 or R15. Resistance of R13 should be approximately 3000 ohms. If starting resistors R13, R14, and R15 are satisfactory, check as follows: measure resistance in both directions between terminals of power rectifier CR1 at which the following color-coded leads are connected: red-white to green-white; green-white to blue-white; blue-white to white-red-brown; white-red-brown to blue. Resistance between each pair of terminals should be high in one direction and low in the other; low resistance in both directions indicates a shorted diode section in CR1.
	Shorted capacitor C3 or C4, L2 or L3 have shorted to negative output	Disconnect load and measure resistance between positive and negative output terminals with red (positive) lead of ohmmeter connected at negative output. This resistance should be low initially, but should then increase as output capacitors C3 and C4 charge.

<u>Symptom</u>	<u>Probable Cause</u>	<u>Check Procedure</u>
Output voltage incorrect	Improper adjustment of potentiometer R7	Continued low resistance may indicate that C3 or C4 has shorted or that windings of output choke L2 or L3 have shorted to negative output. Readjust potentiometer R7.
	Open circuit of diodes CR2 through CR11 or open resistor R9	With Carrier Supply Unit in operation, measure d-c voltage across each of diodes CR2, CR3, and CR4. Nine to twelve volts should appear across each diode. Also measure d-c voltage across each of diodes CR5 through CR11; about 1/3 volt should be developed across each diode. Incorrect voltage across any diode, CR2 through CR11, may indicate a defective diode. No voltage across any diode, CR3 through CR11, indicates an open circuit in one or more diodes or in resistor R9.
	Defective potentiometer R7 or defective resistors R6, R8, R10, R11 or R12	Disconnect input and output leads. Measure resistance between slider of potentiometer R7 and negative output; this resistance should be approximately 200 ohms. Appreciably greater resistance or an open-circuit indicates defective potentiometer R7 or resistor R8. Measure resistance between slider of potentiometer R7 and positive output; if this resistance is considerably greater than 1000 ohms, it indicates defective potentiometer R7 or resistor R6. Measure resistance in both directions between terminal 7 of magnetic amplifier T2 and positive input. This resistance should be low in one direction and between

<u>Symptom</u>	<u>Probable Cause</u>	<u>Check Procedure</u>
		400 and 800 ohms in the other. Greater resistance than 800 ohms in one direction shows defective resistor R11 or R12. Measure resistance between terminal 8 of magnetic amplifier T2 and negative input; this resistance should be between 1500 and 1900 ohms. Greater resistance than 1900 ohms indicates defective resistor R10 or R11.
	Open circuit in control windings of magnetic amplifier T2	Check continuity of magnetic amplifier T2 control windings. Continuity should exist between terminals 5 to 6, 7 to 8, and 9 to 11.
Noise in adjacent equipment	Magnetic field generated by the Carrier Supply Unit	Separate the Carrier Supply Unit from adjacent equipment.
Noise at Carrier Supply Unit load	Faulty output filter capacitor C3 or C4. Magnetic field generated by Carrier Supply Unit	Disconnect load and measure resistance between positive and negative output terminals with red (positive) lead of ohmmeter connected at negative output. This resistance should be low initially, but should then increase as output capacitors C3 and C4 charge. Continued low resistance may indicate that C3 or C4 has shorted. Separate the Carrier Supply Unit from adjacent equipment.
Noise at Carrier Supply Unit input battery	Faulty input filter capacitor C1 or mounting equipment sensitive to a magnetic field, and connected to the Carrier Supply Unit input battery adjacent to the Carrier Supply Unit	Replace C1 if faulty; separate the Carrier Supply Unit from adjacent equipment if necessary.

9. MAJOR COMPONENT TEST

a. Transistors Q1, Q2, Q3, Q4

- (1) Disconnect input battery. As viewed from rear of Carrier Supply Unit, transistors Q1 through Q4 are located on individual heat sinks mounted on a channel bracket at right hand side. Remove heat sink bracket, then remove associated mounting screws and heat sinks from heat sink bracket.
- (2) Note connections to transistor(s) to be tested: each transistor is secured to its heat sink by its threaded collector terminal; of two remaining terminals, larger lead is connected to emitter terminal and smaller lead is connected to base terminal.
- (3) Remove collector terminal nut and collector lead lug(s) from collector terminal. Measure emitter-collector resistance in both directions; this resistance should be considerably greater in one direction than in the other. Resistance less than one ohm in both directions indicates a shorted transistor.
- (4) If a transistor has shorted, its base resistor may be open or corresponding drive windings of power transformer T1 may be open. Each base resistor should have approximately four ohms resistance. To check base resistor, measure resistance between transistor base terminal and corresponding T1 resistor check terminal on transformer T1; to test T1 drive windings, make continuity check between indicated drive winding terminals:

<u>Tran-</u>	<u>Base</u>	<u>Resistor</u>	<u>T1 Drive</u>
<u>sistor</u>	<u>Res.</u>	<u>Check Term.</u>	<u>Wdg Terms.</u>

Q1 ...	R1	2	1-2
Q2 ...	R2	12	1-12
Q3 ...	R3	13	13-14
Q4 ...	R4	3	3-4

- (5) If necessary to replace a transistor, unsolder both base and emitter leads.

CAUTION: When soldering or unsoldering leads to a transistor, do not apply more heat than necessary or damage to transistor may result.

- (6) Insert terminals of replacement transistor through corresponding holes in heat sink; this can be done in only one way since each transistor has a locating key. Install collector lead lug(s) and nut on collector terminal to secure transistor to heat sink, then solder emitter and base leads to corresponding terminals.
- (7) Be certain that insulator at each side of heat sink is in proper position, then secure heat sink to heat sink bracket with two mounting screws.

b. Capacitors C1, C2, C3, C4

- (1) Note connections to capacitor with respect to polarity, then disconnect one lead.
- (2) If possible, check capacitor by measuring its capacitance. Approximate capacitances are as follows:

C1:	2000 microfarads
C2:	0.1 microfarad
C3:	440 microfarads
C4:	440 microfarads

- (3) If a capacitance meter is not available, measure resistance of capacitor with ohmmeter. This resistance should be low initially and increase as capacitor charges. Continued low resistance indicates a short-circuit; initial high resistance indicates a high-resistance connection or open-circuit.

If capacitor C2 has shorted, check resistor R5. A short-circuit in C2 will usually cause R5 to burn out.

c. Power Rectifier CR1

Test instructions for power rectifier CR1 are given in Section 8, above. If power rectifier CR1 is defective, check capacitor C5 and resistor R2. Resistance-capacitance network R2-C5 protects CR1 against voltage spikes; if this network is defective, it may have caused damage to CR1.

d. Diodes CR2 through CR12

Section 8, above, gives test instructions for diodes CR2 through CR12. If necessary to replace any of these diodes:

- (1) Note connections to diode with respect to polarity. Diodes CR2, CR3, and CR4 are imprinted with a diode symbol; diodes CR5 through CR12 have bands at negative end.
- (2) Unsolder and disconnect diode from terminals on component card, then solder replacement diode to terminals being careful to observe correct polarity.

e. Transformer, Chokes, Magnetic Amplifier

Test instructions for power transformer T1, input choke L1, output chokes L2 and L3, and magnetic amplifier T2 are given in Section 8, above.

If necessary to replace power transformer T1 or magnetic amplifier T2, be certain to note connections carefully to assure correct connections to replacement component.

f. Resistors R8 and R11

If it is necessary to replace either resistor R8 or R11, adjustment of replacement resistor must be made. Refer to Section 10, below, for resistor adjustment procedures.

10. RESISTOR ADJUSTMENT

a. Resistor R8 Adjustment

Setting of resistor R8 determines range over which potentiometer R7 will adjust Carrier Supply Unit output voltage. When a new resistor R8 has been installed, first turn potentiometer R7 to center of its range, then:

- (1) Operate Carrier Supply Unit, note output voltage, then remove input fuse F1 to turn off Carrier Supply Unit.
- (2) If output voltage is lower than 130 volts, increase resistance of R8; if output voltage is higher than 130 volts, decrease resistance of R8. Install input fuse F1 and repeat (1), above, as necessary to bring output voltage to approximately 130 volts.

b. Resistor R11 Adjustment

Resistor R11 is adjusted to establish output voltage regulation characteristics of Carrier Supply Unit with respect to d-c input voltage variations. If a new resistor R11 has been installed:

(1) Connect a variable resistance, capable of carrying at least ten amperes, in series between battery and Carrier Supply Unit input. Adjust resistance so that input voltage is 42 volts.

(2) Connect a 0-3 volt d-c voltmeter between anode of CR2 (voltmeter positive) and slider of resistor R11 (voltmeter negative). Adjust R11 so that voltmeter indicates between 0.05 volt and 0.15 volt.

LORAIN PRODUCTS CORPORATION
Lorain, Ohio, U. S. A.

LORAIN PRODUCTS (CANADA) LTD.
St. Thomas, Ontario, Canada

April 5, 1971

ELECTRICAL PARTS LIST
LORAIN MODEL CST1 DC TO DC CONVERTER
SPEC. NO. 5664-013

The quantity of spare parts (except fuses) listed should be sufficient for ten or less CST1 DC TO DC CONVERTERS for at least 18 months. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate.

<u>Ref.</u> <u>Desiq.</u>	<u>LPC</u> <u>Part No.</u>	<u>Description</u>	<u>Quantity</u> <u>Rec. Spares</u>
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ASSEMBLIES

A1	4257-510	Transistor Heat Sink	**
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CAPACITORS

C1	2731-270	2000UF 60V, Electrolytic	1
C2	2713-443	.1UF 600V	1
C3	2731-683	450UF 200V, Electrolytic	1
C4	2731-683	450UF 200V, Electrolytic	*

DIODES

CR1A	2812-541	1N4722, Silicon	3
CR1B	2812-541	1N4722, Silicon	*
CR1C	2812-541	1N4722, Silicon	*
CR1D	2812-541	1N4722, Silicon	*
CR2	2836-125	1N961A, Zener	2
CR3	2836-125	1N961A, Zener	*
CR4	2836-125	1N961A, Zener	*
CR5	2831-116	Germanium Stabistor	4
CR6	2831-116	Germanium Stabistor	*
CR7	2831-116	Germanium Stabistor	*
CR8	2831-116	Germanium Stabistor	*
CR9	2831-116	Germanium Stabistor	*
CR10	2831-116	Germanium Stabistor	*
CR11	2831-116	Germanium Stabistor	*
CR12	2812-541	1N4722, Silicon	*
CR13	2812-131	1N538, Silicon	1

FUSES

F1	2483-258	10A, Cartridge	3
F2	2483-233	3A, Cartridge	3

*This part appears more than once in this list.

Use recommended spare quantity stated where part first appears in this list.

**For Rec. Spares, refer to Electrical Parts List for this assembly.

ELECTRICAL PARTS LIST
LORAIN MODEL CST1 DC TO DC CONVERTER
SPEC. NO. 5664-013

<u>Ref. Desig.</u>	<u>LPC Part No.</u>	<u>Description</u>	<u>Quantity Rec. Spares</u>
<u>INDICATOR LAMPS</u>			
DS1	2581-213	48V, Filament	1
<u>INDUCTORS</u>			
L1	4415-003	Input Choke	-
L2	4423-010	Output Choke	-
L3	4423-010	Output Choke	-
<u>METERS</u>			
M1	2943-213	0-150V DC, Voltmeter	-
M2	2923-204	0-3A DC, Ammeter	-
<u>RELAYS</u>			
K1	2542-911	130V, Telephone	1
<u>RESISTORS</u>			
R1	2656-408	4 Ohm 10W, Fixed	1
R2	2656-408	4 Ohm 10W, Fixed	*
R3	2656-408	4 Ohm 10W, Fixed	*
R4	2656-408	4 Ohm 10W, Fixed	*
R5	2652-324	250 Ohm 10W, Fixed	1
R6	2656-549	1K Ohm 25W, Fixed	1
R7	2683-238	75 Ohm 2W, Variable	1
R8	2681-415	250 Ohm 10W, Adjustable	1
R9	2652-361	25K Ohm 10W, Fixed	1
R10	2652-339	1.5K Ohm 10W, Fixed	1
R11	2681-418	400 Ohm 10W, Adjustable	1
R12	2651-727	400 Ohm 5W, Fixed	1
R13	2651-744	3K Ohm 5W, Fixed	1
R14	2651-732	750 Ohm 5W, Fixed	1
R15	2651-732	750 Ohm 5W, Fixed	*
R16	2651-754	10K Ohm 5W, Fixed	1
R18	2615-263	1.0K Ohm .5W, Fixed	1
R19	2652-302	1 Ohm 10W, Fixed	1
R20	2615-697	250 Ohm 10W, Adjustable	1
R22	2651-754	10K Ohm 5W, Fixed	*
R23	2615-255	470 Ohm 1/2W	1
<u>TRANSFORMERS</u>			
T1	4516-501	Power	-
T2	4556-501	Transductor	-

ELECTRICAL PARTS LIST
LORAIN MODEL CST1 DC TO DC CONVERTER
SPEC. NO. 5664-013

<u>Ref.</u> <u>Desig.</u>	<u>LPC</u> <u>Part No.</u>	<u>Description</u>	<u>Quantity</u> <u>Rec. Spares</u>
<u>TRANSISTORS</u>			
Q5	2841-025	2N333A	1
<u>MISCELLANEOUS</u>			
X1	2488-106	Fuseholder	1
X3	2584-113	Lampholder	1
MP4	2584-636	Cap, Lens, Red	1

LORAIN PRODUCTS CORP.
Lorain, Ohio
April 30, 1970

Printed in U.S.A.

lhs

ELECTRICAL PARTS LIST
LORAIN 4257-510 TRANSISTOR HEAT SINK ASSEMBLY

The quantity of spare parts (except fuses) listed should be sufficient for ten or less TRANSISTOR HEAT SINK ASSEMBLIES for at least 18 months.

<u>Ref.</u> <u>Desig.</u>	<u>LPC</u> <u>Part No.</u>	<u>Description</u>	<u>Quantity</u> <u>Rec. Spares</u>
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TRANSISTORS

Q1	2848-150	15A, Germanium	2
Q2	2848-150	15A, Germanium	*
Q3	2848-150	15A, Germanium	*
Q4	2848-150	15A, Germanium	*

*This part appears more than once in this list.
Use recommended spare quantity stated where part
first appears in this list.

LORAIN PRODUCTS CORP.
Lorain, Ohio
April 20, 1970

Printed in U.S.A.

lhs

MANUFACTURING NOTES:

1. ALL WIRES SHALL BE 20GA STRANDED UNLESS OTHERWISE SPECIFIED.
2. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES IN MICROFARADS.
3. A - ADJUSTABLE LEAD; TO BE SOLDERED BY TESTER.
4. BI - TERMINAL NEAREST MOUNTING SURFACE.
5. D - INDICATES LEAD IS A JUMPER.
6. (H1), (H2) - WIRES RUN THROUGH CORRESPONDINGLY DESIGNATED HOLES.
7. P - PAIRED TWISTED WIRES.
8. PT - LEADS WHICH ARE PART OF COMPONENTS
9. THESE WIRES TO BE CONNECTED ON BOTTOM SIDE OF COMPONENT BOARD.
10. THESE WIRES ARE CONNECTED ON BOTTOM SIDE OF TERMINAL STRIP. JUMPERS ON FRONT SIDE ARE CONNECTED FOR NEG. OUTPUT GROUND. FOR POSITIVE OUTPUT GROUND, JUMPER TERMINALS 14 TO 15 TO 16, 17 TO 22, 18 TO 23, AND 19 TO 20 TO 21. JUMPERS TO BE LUGGED WITH 2453-361.

00

(T2)
4556-501
TRANSDUCTOR

01

(A1)
J-804-37
COMP. BD.

02

(R21)
2681-415
250
10 WATT

03

(R8)
2681-415
250
10 WATT

04

(R18)
2615-263
1000
1/2 WATT

05

(R7)
2683-238
75
2 WATT
POT.

06

(R19)
2652-302
10 WATT

07

(R6)
2656-549
1000
25 WATT

08

(R9)
2652-361
2500
10 WATT

HI

NOTE 9

SHEET 1 OF 3
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FIG. 2
UNDER SIDE OF METER PANEL

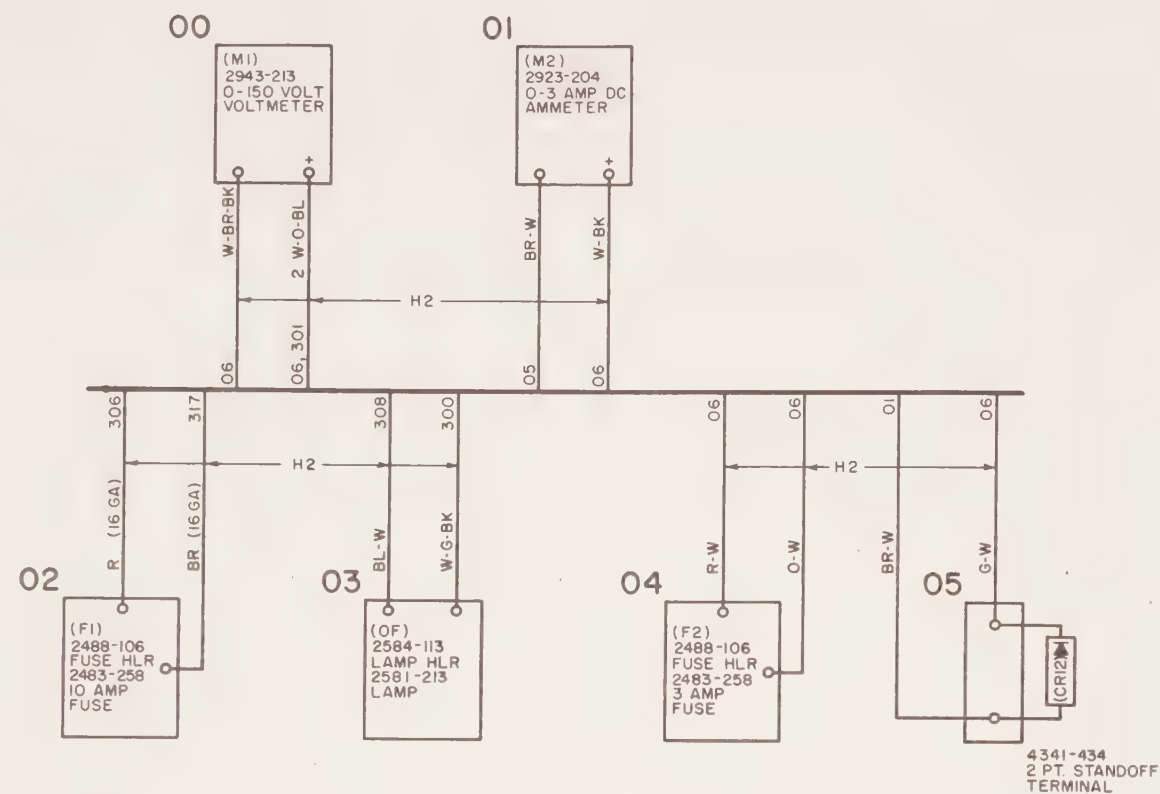
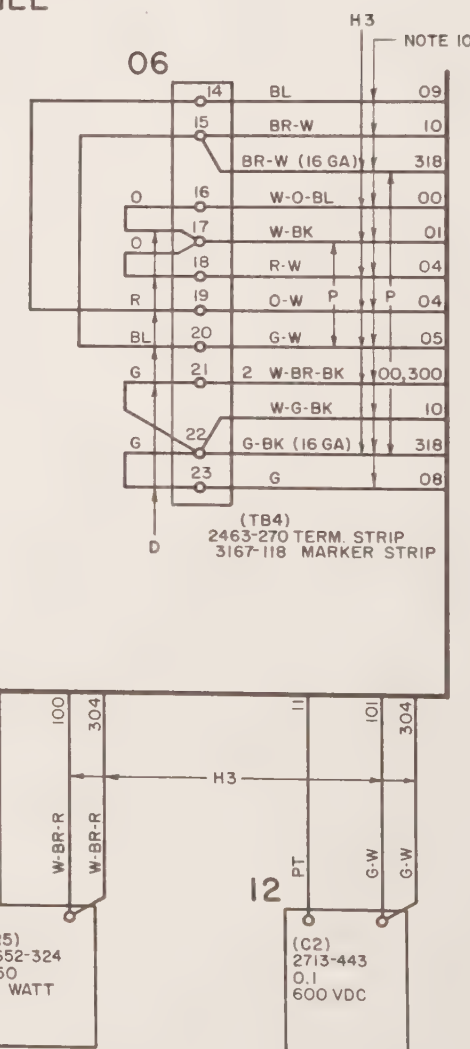


FIG. 3
RIGHT SIDE OF METER PANEL



PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
CR12			05

DRAWING ISSUE	
1	07-17-61
2	07-18-61
3	07-20-61

ISSUE
3

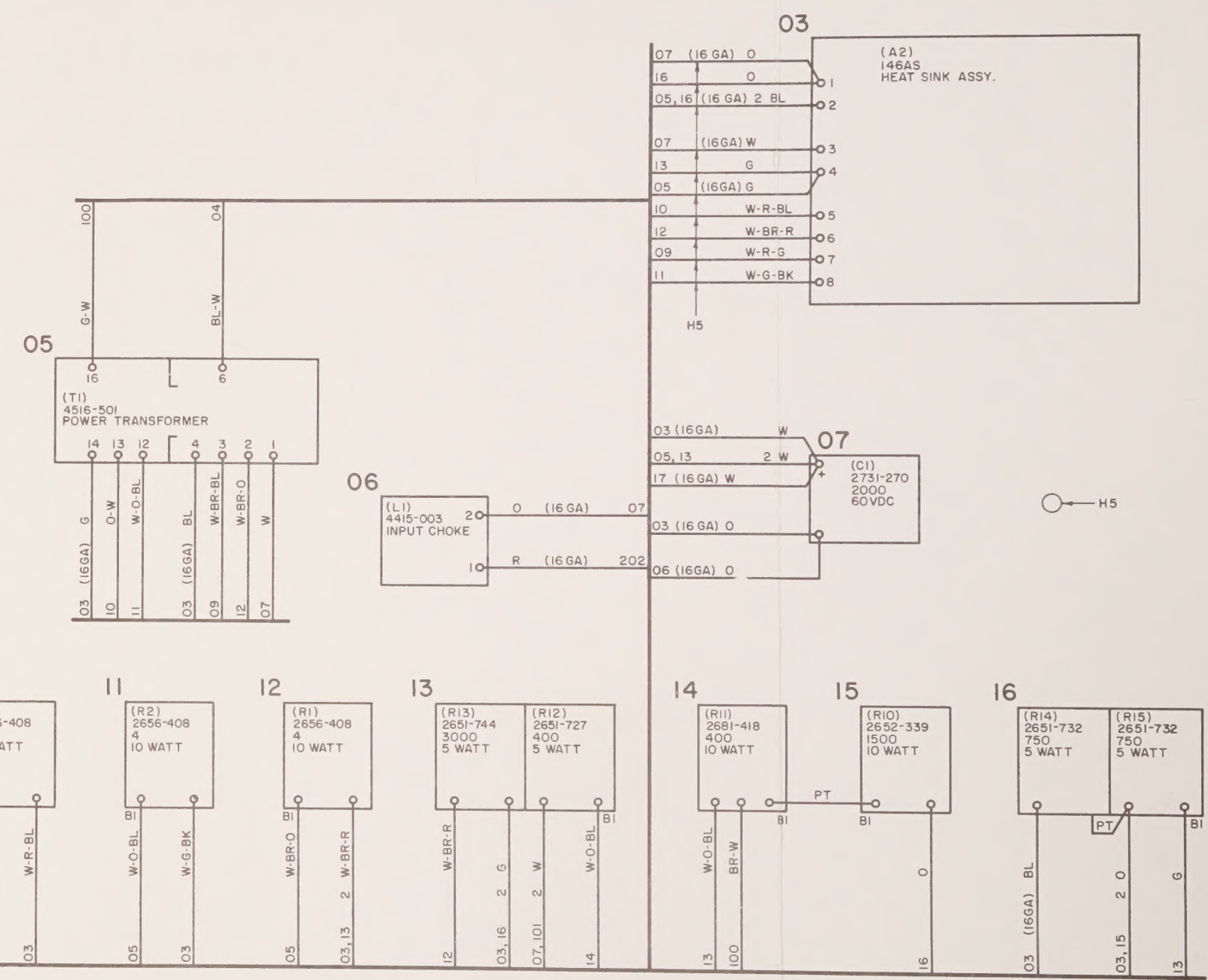
T-5664-013

LORAIN PRODUCTS CORPORATION

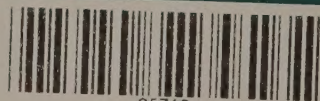
DWG SIZE
D

SHEET 2 OF 3
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FIG. 5
BOTTOM SIDE OF SUPPORT BRACKET



PIGTAIL COMPONENT INFORMATION			
REF DESIG.	LPC PART NO.	VALUE	LOC
CRIA- CRID			04
R23	2615-255	470	04



85710